

FUNCTIONAL MRI FOR LANGUAGE LOCALIZATION

Language Dominance in Partial Epilepsy Patients Identified with an fMRI Reading Task

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BACKGROUND: Functional magnetic resonance imaging (fMRI) language tasks readily identify frontal language areas; temporal activation has been less consistent. No studies have compared clinical visual judgment with quantitative region-of-interest (ROI) analysis.

OBJECTIVE: To identify temporal language areas in patients with partial epilepsy by using a reading paradigm with clinical and ROI interpretation.

METHODS: Thirty patients with temporal lobe epilepsy, aged 8 to 56 years, had 1.5-T fMRI. Patients silently named an object described by a sentence compared with a visual control. Data were analyzed with ROI analysis from t-maps. Regional asymmetry indices (AIs) were calculated ($(L-R)/(L+R)$), and language dominance defined as >0.20 . t-Maps were visually rated by three readers at three t thresholds. Twenty-one patients had the intracarotid amobarbital test (IAT).

RESULTS: The fMRI reading task provided evidence of language lateralization in 27 of 30 patients with ROI analysis. Twenty-five were left dominant, two right, one bilateral, and two were nondiagnostic; IAT and fMRI agreed in most patients; three had partial agreement, and none overtly disagreed. Interrater agreement ranged between 0.77 to 0.82 (Cramer V; $p < 0.0001$); agreement between visual and ROI reading with IAT was 0.71 to 0.77 (Cramer V; $p < 0.0001$). Viewing data at lower thresholds added interpretation to 12 patients on visual analysis and eight with ROI analysis.

CONCLUSIONS: An fMRI reading paradigm can identify language dominance in frontal and temporal areas. Clinical visual interpretation is comparable to quantitative ROI analysis.

COMMENTARY

The identification of cerebral cortex with important language function may be necessary in selected patients with intractable partial or localization-related epilepsy being considered for surgical treatment. The preoperative methods used at present to identify the frontal lobe and temporal lobe language areas include the intracarotid amobarbital test (IAT) or extraoperative cortical stimulation mapping. These procedures are invasive, may have significant potential limitations, and do not lend themselves to repeated studies. The development of innovative and noninvasive techniques to lateralize and localize language areas would represent a significant advance in the care and management of patients with surgically remediable epileptic syndromes. Functional MRI (fMRI) is a technique with excellent spatial resolution that is a hemodynamic indicator of neuronal activity associated with the performance of a specific task. fMRI has previously been demonstrated to be a noninvasive means to localize frontal lobe language areas. The use of verbal fluency tasks may result in frontal lobe activation, but they are inadequate to localize temporal lobe areas. Identification of temporal lobe language areas may be important in patients with partial epilepsy of temporal lobe origin being considered for surgery. This group of investigators has shown the importance of a reading-based naming paradigm for temporal lobe activation in individual subjects.

The present study by Gaillard et al. evaluated the potential use of fMRI to identify temporal lobe language areas in 30 patients with temporal lobe epilepsy. The investigators used a reading response–naming paradigm with clinical and region-of-interest (ROI) quantitative analysis. The reading task provided evidence of language lateralization in 27 of 30 patients with ROI analysis. The diagnostic yield of visual interpretation and ROI analysis was similar. Twenty-five were left hemisphere dominant; two, right hemisphere dominant; and one, bilateral. The fMRI activating tasks were nondiagnostic in two patients. IAT was performed to determine hemisphere dominance for language in 20 of the 30 patients. The IAT and fMRI findings concurred in most patients, with three individuals having a “partial agreement.” In no instances were these two studies associated with contradictory lateralizations.

The present study indicates that fMRI allows identifica-

tion of frontal lobe and temporal lobe language areas in most patients with temporal lobe epilepsy being considered for focal cortical resection. The well-written editorial accompanying this article (Abou-Khalil B, Schlaggar BL. Is it time to replace the Wada test? *Neurology* 2002;59:160–161) evaluates the role of fMRI in potential surgical candidates. fMRI may now be sufficient to determine hemispheric dominance for language. There is, however, much work that remains before

using the fMRI findings to obviate intraoperative or extraoperative cortical stimulation mapping in patients undergoing a focal corticectomy in or near language areas. The current study by Gaillard et al. is provocative and will require confirmation and validation.

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